Ecological engineering:

from concepts to applications

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Using cover crops to enhance ecological services in orchards: A multiple criteria and systemic approach applied to tropical areas

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Abstract

Conventional agriculture is based on a high level of chemical inputs such as pesticides and fertilisers, leading to serious environmental impacts, health risks and loss of biodiversity. In both temperate and tropical agricultures, the reduction of pesticide use is a priority for intensive agricultural systems such as orchards. Reintroducing biological diversity in single crop cropping systems can enhance biological regulations (Malézieux et al., 2009) and hence contribute to reduce or eliminate the use of chemicals (Simon et al., 2009) and to provide additional services such as run-off and erosion control (Zuazo and Pleguezuelo, 2008). In tropical wet areas, weed control is crucial but difficult to manage without herbicides especially when orchards are not located in easily mechanised areas and when labour force is costly (Lavigne et al., 2007). Cover plants are a plant component that can be easily introduced in orchard systems. Based on this assumption, we developed an agro ecological approach in French West Indies that consists in introducing adapted cover plants in single crop citrus orchard systems to control weeds and provide additional ecological services.

A multi criteria evaluation grid was built to select an "optimal" cover crop. Specific criteria were first defined related to local climate, and seed availability in the island (limitation of alien species introduction). In both Martinique and Guadeloupe 202 species were selected in the local flora. Specific features were then determined according to the agronomic potential and ecological services for an optimal cover crop. Criteria included weed control, the ability to control runoff and erosion, water and nutrient competition, pests and natural enemies hosting capacity. The evaluation grid was built from combined data issued from literature, expert assessment and experimental mesurements.

Optimum cover crop functional groups were defined according to the considered agrosystem and associated objectives in each island. In Guadeloupe, a participative approach led first to the selection of nitrogen fixing plants (Fabacea plants, *Neotonia wightii*, *Stylosanthes hamata*) characterized by high auxiliaries hosting services. These services were assessed using a bio-indicator (family of phytoseiidae). In Martinique, the need for a high covering index associated with a low biomass production led to the selection of grasses: *Urochloa mozambicensis* and three *Paspalums.* Thus, the number of candidate cover plants, at the end of the selection process, was limited.

The multicriteria grid can be used as a generic tool to select cover crops that can be easily adapted according various cropping systems. Its use for banana cropping system is in progress. However, the concept of an optimal cover plant remains difficult to achieve and the construction of a mixture cover system is often required to to reach the seeked efficiency.

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